Strontium-90 and Gross Beta Activity in the Fat and Nonfat Fractions of the Liver of the Coconut Crab *(Birgus latro)* Collected at Rongelap Atoll during March 1958

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THERE HAS BEEN a large individual variability in the levels of radioactivity per unit weight of biological samples collected in the vicinity of the Eniwetok Test Site (Applied Fisheries Laboratory, 1949, 1953, 1955*a*, 1955*b*; Held, 1960). This variability may be great enough to mask or obscure differences which might exist between species or with time or locality of collection. In most cases, practical considerations do not permit increasing the number of samples in an attempt to elucidate possible differences. The work reported in this paper points out a source of variability that exists in comparing the radioactivity of various samples of coconut crab liver.

Birgus latro, the coconut crab, is of particular interest since it is edible and is known to concentrate strontium-90. In the course of preparing samples of *B. latro* liver for radioassay, it appeared that the fat content varied considerably from specimen to specimen. A crude determination indicated that the fat contained little or no radioactivity, which was expected because of the low mineral content of fat.

It was therefore decided to determine accurately the fat content and the proportions of strontium-90 and gross beta activity in the fat and nonfat fractions. The objective was to determine whether more uniform results could be obtained when radioisotopic content was expressed on a basis of nonfat solids rather than total solids as had been done in the past.

MATERIALS AND METHODS

Liver samples of the coconut crab were collected from Kabelle, Rongelap, and Eniaetok islands at Rongelap Atoll in March, 1958. The samples were oven-dried at 98 $\pm$ 2° C. and partially pulverized. The fat was extracted from the dried samples by a modification of the Johnson method (Winton and Winton, 1945). Petroleum ether was used as the extracting solvent. The fat-free solids were wet-ashed with concentrated HNO_3 and H_2O_2. The ash obtained from nonfat solids was dissolved in a known volume of 1 N HNO_3 and the strontium-90 levels of the samples were determined by the method of Kawabata and Held (1958). The gross beta activity was also measured from an aliquot of the solution. The fat content was determined on a dry weight basis by weighing and on a wet weight basis by using the wet weight to dry weight ratios shown in Table 1. The fat samples were dry-ashed in a muffle furnace at 550° C. overnight. The ash obtained from the fat fraction was dissolved in a small volume of 1 N HNO_3 and was transferred to a plate for determining the gross beta activity. The gross beta activity of the fat fraction was less than 1 per cent of that in the nonfat fraction, making strontium-90 determinations impractical with the facilities available.

All counting was done with an Anton end-window Geiger tube, number 1001-T, which was standardized against a National Bureau of Standards strontium-90 standard.

RESULTS AND DISCUSSION

The ratio of wet to dry weight and the fat content of the liver samples are presented in Table 1. The fat constituted an average of 47 per cent by weight on a wet basis, with a standard deviation of 9.71; and of 74 per cent by weight on a dry weight basis, with a standard deviation of 9.29. The average ratio of wet to dry weight was 1.603, with a standard deviation of 0.156, indicating that the moisture level of the samples was relatively constant.

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TABLE 1

PERCENTAGE OF FAT CONTENT AND THE RATIO OF WET WEIGHT TO DRY WEIGHT OF LIVERS* OF THE COCONUT CRAB *(Birgus latro)* COLLECTED AT RONGELAP ATOLL IN MARCH, 1958

SAMPLE NUMBER	PERCENTAGE OF FAT IN LIVER		WET WEIGHT / DRY WEIGHT
	Wet	Dry	
34	44.70	78.81	1.763
35	48.24	74.38	1.542
36	31.50	55.37	1.758
37	38.01	67.88	1.786
38	42.34	67.99	1.606
61	40.38	71.83	1.779
62	42.76	73.04	1.708
84	56.10	83.20	1.483
85	64.62	87.69	1.357
86	50.76	71.02	1.399
87	61.49	88.55	1.440
88	43.89	70.97	1.617
Mean	47.07	74.23	1.603
Standard deviation	9.71	9.29	0.156

* Sample weights ranged from 9 to 18 g.

Strontium-90 levels expressed as disintegrations per minute per gram of nonfat solids and of total solids given on a dry weight and a wet weight basis are presented in Table 2.

Table 3 presents the gross beta activity in the fat and nonfat fractions of the liver. Although fat constituted an average of 47 per cent of the wet weight and 74 per cent of the dry weight (Table 1) of the total solids, gross beta activity of the fat fraction amounted to less than 0.5 per cent of the total sample on a wet weight basis, and less than 1.0 per cent on a dry weight basis.

The gross beta activity of the samples on a wet and dry weight basis is given in Table 4.

There is a linear relationship between strontium-90 activity and gross beta activity (Tables 2, 3). The percentage of gross beta activity due to strontium-90 at Kabelle, Eniaetok, and Rongelap islands, on a nonfat solid dry weight basis, and based upon the average values at each island, is 32, 35, and 31 per cent, respectively.

TABLE 2

STRONTIUM-90 IN NONFAT SOLID AND TOTAL SOLIDS IN LIVERS OF THE COCONUT CRAB *(Birgus latro)*

SAMPLE NUMBER	LOCATION OF COLLECTION	NONFAT SOLIDS d/m/g		TOTAL SOLIDS d/m/g	
		Wet	Dry	Wet	Dry
34	Rongelap Atoll	260 ± 10*	458 ± 17*	55 ± 2*	97 ± 4
35		353 ± 13	544 ± 20	90 ± 3	140 ± 5
36	Kabelle Island	276 ± 12	484 ± 20	130 ± 5	288 ± 10
37		605 ± 35	1080 ± 44	194 ± 8	347 ± 14
38		420 ± 20	674 ± 33	134 ± 6	216 ± 11
Mean		383	648	121	218
Standard deviation		140	255	52	103
84	Rongelap Island	236 ± 10	350 ± 15	40 ± 2	59 ± 3
85		245 ± 11	332 ± 13	30 ± 1	41 ± 2
86		159 ± 8	222 ± 10	46 ± 2	64 ± 3
87		409 ± 23	589 ± 33	47 ± 3	67 ± 4
88		224 ± 13	362 ± 21	65 ± 4	105 ± 6
Mean		255	371	46	67
Standard deviation		93	134	13	23
61	Eniaetok Island	248 ± 9	442 ± 17	70 ± 3	124 ± 5
62		321 ± 20	548 ± 34	87 ± 5	148 ± 9
Mean		285	495	79	136
Standard deviation		52	75	12	17

* Counting error is less than 7 per cent.

TABLE 3

GROSS BETA ACTIVITY OF FAT AND NONFAT FRACTIONS AND PERCENTAGE OF GROSS BETA ACTIVITY IN FAT OF COCONUT CRAB (*Birgus latro*) LIVER

SAMPLE NUMBER	LOCATION OF COLLECTION	FAT d/m/g*	NONFAT d/m/g*		PERCENTAGE OF GROSS BETA ACTIVITY DUE TO FAT	
			Wet weight basis	Dry weight basis	Wet weight basis	Dry weight basis
34	Rongelap Atoll	4	1116	1967	0.29	0.77
35		8	1086	1674	0.67	1.36
36	Kabelle Island	6	618	1086	0.45	0.68
37		14	1929	3446	0.44	0.84
38		2	1219	1958	0.11	0.22
Mean		7	1194	2026	0.39	0.77
84	Rongelap Island	1	753	1117	0.18	0.42
85		0	661	897	0.00	0.00
86		–2	513	718	0.00	0.00
87		1	1169	1684	0.13	0.45
88		1	545	882	0.13	0.26
Mean		0.2	728	1060	0.09	0.23
61	Eniaetok Island	6	824	1466	0.49	0.99
62		6	984	1681	0.45	0.97
Mean		6	904	1573	0.47	0.98

* Counting error is less than 8 per cent.

TABLE 4

GROSS BETA ACTIVITY OF LIVER OF THE COCONUT CRAB (*Birgus latro*)

SAMPLE NUMBER	LOCATION OF COLLECTION	TOTAL SAMPLE d/m/g*	
		Wet weight basis	Dry weight basis
34	Rongelap Atoll	617	431
35		563	428
36	Kabelle Island	423	485
37		1196	1110
38		702	627
Mean		700	616
Standard deviation		295	288
84	Rongelap Island	330	188
85		234	110
86		253	208
87		450	194
88		306	257
Mean		315	191
Standard deviation		85	52
61	Eniaetok Island	492	413
62		564	454
Mean		528	434
Standard deviation		51	29

* Counting error is less than 8 per cent.

The strontium units for the liver of coconut crab of earlier collections from Rongelap have been reported previously (Applied Fisheries Laboratory, 1955*a*, 1955*b*; Dunning, 1957). In order to report the strontium units for the March, 1958, collection, Table 5 has been included.

Since the results of these studies show that the fat content is variable and the fat fraction contains practically no minerals or radioactivity, radiochemical analyses of the liver of coconut crab should be made on the basis of nonfat solids rather than on the entire liver, as has been done in the past.

SUMMARY

The values for strontium-90 and gross beta activity in the fat and nonfat fractions from the livers of 12 coconut crabs (*Birgus latro*) collected at Rongelap Atoll during March, 1958, are presented.

Although fat constituted an average of 47 per cent by weight on a wet weight basis (74 per cent on a dry weight basis), gross beta activity of the fat fraction amounted to less than 0.5 per cent of the total activity on a wet weight basis. Fat content on a wet weight basis had a range of 31 to 65 per cent. There is a linear relationship between strontium-90 activity and gross beta activity. Since the fat content of coconut crab liver is variable and the fat fraction contains practically no radioactivity, it is suggested that the radioactivity (and mineral content) of liver samples be compared on the basis of the nonfat solids.

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TABLE 5

STRONTIUM UNITS AND CALCIUM IN LIVER OF THE COCONUT CRAB (*Birgus latro*)

SAMPLE NUMBER	LOCATION OF COLLECTION	Sr^{90} d/m/g WET WEIGHT BASIS	mg. Ca/g WET WEIGHT BASIS	STRONTIUM UNITS*
34	Rongelap Atoll	55	7.25	3448
35		90	10.03	4079
36	Kabelle Island	130	23.93	2469
37		194	15.72	5609
38		134	17.18	3545
Mean		121	14.82	3830
Standard deviation		52	6.51	1152
84	Rongelap Island	40	8.39	2167
85		30	5.40	2525
86		46	12.67	1650
87		47	6.18	3457
88		65	10.99	2688
Mean		46	8.73	2497
Standard deviation		13	3.09	668
61	Eniaetok Island	70	8.00	3977
62		87	7.22	5477
Mean		79	7.61	4727
Standard deviation		12	0.55	1055

* Strontium unit = micro-microcurie of Sr^{90} per gram of calcium.

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